D. FOLSOM

The Potato News Bulletin

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ANNOUNCEMENT

It is with considerable pleasure that your secretary is able to announce the publication of the annual report containing the proceedings of the tenth annual meeting of the Association. This year's report contains 212 pages or an even 100 pages more than that of the preceding year. Naturally this increase in number of pages has very materially enhanced the cost of the publication, with the result that your secretary-treasurer now faces a considerable deficit. In view of the increased cost of the publication and the deficit mentioned the report has only been mailed to those who were members of the Association prior to February 1st. In order to overcome this deficit it is proposed to sell the surplus copies at $1.50 per copy postage prepaid. In the meantime the writer proposes to assume the present indebtedness and issue the April number of the News Bulletin. Further publication of " The Potato News Bulletin " will be dependent upon the interest shown by the members of the Association in securing new members or in the sale of advertising space in the News Bulletin. The following tentative scale of prices is submitted as a guide to those desiring to purchase space: Full page, $10.00; half page, $5.50; quarter page, $3.00; eighth page, $2.00; back cover page, $15.00. Unless a large increase in membership is secured, or donations received, the cost of publishing further numbers of the Potato News Bulletin must be met out of the proceeds received from the sale of advertising space.— **W. Stuart.**

POTATO NOTES

British Columbia.— There is a very keen demand for certified seed potatoes for planting this year, particularly early varieties — in fact the growers cannot meet the demand. The potato show held in Victoria last November has given the seed certification

work a decided boost. The price ranges from $50.00 to $65.00 per ton f. o. b. shipping point.— **C. Tice, Department of Agriculture, Victoria, B. C.**

Greeley, Colorado.— A heavy snow with the mercury registering 10° F. below zero has almost completely stopped the hauling of potatoes. It is estimated that there are about 1,000 cars of potatoes left in northern Colorado, and probably another thousand in the remainder of the state.

Potato prices have advanced to 90 cents per hundred-weight, and there are rumors that the price will probably soon be at $1.00. (Price March 29 was $1.35 to 1.40 per cwt.—W. S.)

It is believed that with orderly marketing the price should remain at the present level and possibly may go a little higher.— **W. C. Edmundson, March 17.**

Florida Notes.— According to the March 15 issue of the Fruit Trade Journal and Produce Record, the first car of Spaulding No.4 potatoes from Florida brought $10.00 to $12.00 per barrell, f. o. b. Wabasco. This price is considered equal to $10.50 and $12.50 f. o. b. Hastings, Florida. The Miles-Conley Co., of Baltimore, Md., purchased this car. It is claimed that this price is $2.00 per abrrel above the opening price for Spaulding No. 4 last year. The growers sales agent has also disposed of four additional cars of Spaulding No. 4 from East Coast points at the same price. Those in a good position to know believe that a good season is in store for both grower and shipper of the Spaulding No. 4.

In the Federal Point section, where the earliest planting in the Hastings district is made, digging will be begin about the last of March.

The late February frosts in the Everglades has retarded the growth of the Triumph, and shipments are not expected before the last of the month.

The New Smyrna crop of Triumph, consisting of between 400 to 500 acres, will probably begin to move about March 22.— **W. Stuart.**

Louisiana.— The Louisiana Extension Service has recently announced that their second annual potato tour will take place April 14-18. The tour will be conducted by the various local potato interests and the Horticultural Department of the Louisiana State University Extension Division, with Horticulturist G. L. Tiebout in charge. On Monday and Tuesday, April 14 and 15, there will be a field meeting of The Potato Association of America and Louisiana growers at the New University Farm near Baton Rouge, where, according to Professor Tiebout, is to be found the largest number of lots of certified Triumph seed potatoes ever assembled at one point in the United States. These lots which have been planted in adjacent rows will furnish visitors an excellent opportunity to study the behavior of strains of Triumph from several

states and many localities. Several state representatives have indicated their intention of attending this tour. These include H. O. Werner, from Nebraska; Dr. A. T. Evans, from South Dakota; Dr. H. L. Bolley, from North Dakota; Prof. F. M. Harrington, from Montana; Mr. Luther, from Wisconsin; and the writer.

On April 16 it is planned to visit the Delta Farms at Lockport where several hundred acres have been planted with certified seed. Thursday, April 17, will be spent in the Terrebonne district where a large number of members of boys' and girls' potato clubs are taking an active part in spreading the gospel of good seed potatoes through the direction of the Louisiana State Extension Division, and the co-operation of Nebraska growers of certified seed, who have donated seed, and the Barrett Company of New York, in furnishing sulphate of ammonia. Friday, April 18, is to be spent in the Alexandria district, where the party will tour one of the most exclusive Triumph producing sections in the State.—**W. Stuart.**

Arkport, N. Y.— Present indications are that there will be a slight increase in the potato acreage for 1924, especially among the growers who make it a business, and a slight decrease in the tenant farmers who jump in and out.

Considerable interest is being manifested in certified seed. There is probably a two or three hundred per cent increase in its use.

Present holdings are about the same as last year although a larger per cent will be available for market as the stock runs so much better.

Steuben County is an old established potato growing section, and some growers think that potash is essential to the quality of the stock grown. There will be a heavier application of potash than at any previous time since the beginning of the war.—**Seymour Bridge, March 24.**

Marathon, N. Y. — Certified seed from Cortland Co. seems to be moving along quite briskly with only about 20 per cent held back for later shipments. Up to date average pool prices have been 1.73 f. o. b. loading points. The seed is coming out of storage with a very small percentage of shrinkage and in excellent condition.

Table stock not very active: offering only 60c to 65c per bu. However, most stock has moved from this section, only about 15 per cent remaining in growers' hands. — **Glen Carter, March 24.**

Saquoit, N. Y. — The acreage in this locality will be increased about 8 per cent.

Shipping prices have equaled our nearest city (Utica) market prices. This has increased shipments considerably, and has induced growers to plant on a larger scale for commercial purposes.

The acreage for certified seed purposes will be somewhat increased.

Owing to the unpromising condition of the dairy industry at present and scarcity of farm labor, as a result of our proximity to the industrial towns of the Mohawk Valley, farmers are planning to raise more cash crops.

Table stock is pretty well cleaned up in this section. — **A. G. Allen, March 25.**

Nichols, N. Y.— The writer recently spent five days in the produce sections of five eastern cities, including New York and Philadelphia, and examined many cars of potatoes in the railroad yards. He has been doing this regularly for over a dozen years. As usual, cities do most of their potato buying by discriminating in favor of potatoes from one producing section and against those from another. The principal sections shipping these cities in late winter are Long Island, Maine, south-eastern Pennsylvania, up-state New York and Michigan. Owing to climatic conditions, the potatoes from a section may be very good one year, and very nearly unsalable the next. Such an example is Maine this year. Green Mountains from Maine are cooking "just like flour," are even sized, free from rot and are selling very close to Long Islands' in price this winter. It is only a few years ago that Maine had a record-breaking potato crop in size, but unfortunately so largely made up of overgrown and hollow-hearted tubers that it had to be sold at prices ruinous to the growers. Pennsylvanias' this year are said to cook well, but owing to the drought of last summer run uneven in size with a large proportion of tubers showing undesirable second-growth. "States" as potatoes from up-state New York are called are showing very poor quality this year. Early frost killed many fields in low valleys in the southern part of the state, while the hill farms a mile away often had no killing frost till late October. The small tubers from the valleys mixed with overgrown hollow "lungers" from the hill farms make very poor looking potatoes in the eyes of the city housewife. Wire-worm injury is very common in "states", and complaint is frequently made of their cooking dark in color, in contrast with the very good cooking quality of Maines'. Michigan stock has been selling poorly in eastern cities, being largely overgrown, hollow and dark in color.

The potato grower has no control over the dates of killing frosts, but he can, to a considerable extent, reduce the effects of other troubles upon the sale value of his crop by careful study of the use of better seed, spraying when needed, fertilization and rotation, and better methods of culture and grading. — **Daniel Dean, Nichols, N. Y., March 13.**

Eastern Virginia. — Although the exceptionally cool weather has retarded the work to some extent this season the truckers in the vicinity of Norfolk and also in Northampton county have practically finished planting their spring crop of Cobblers. Planting in Accomac county is still in progress but will probably be

completed by the last of this month. The acreage in the vicinity of Norfolk is about normal, while in Northampton and Accomac counties it is estimated that there is a 10 to 15 per cent increase. Definite figures of the acreage are not available at this time but will be obtained early in April.

No reports of potatoes rotting in the fields have been received thus far. The weather has been too cool for the potatoes to sprout very rapidly but in all instances the seed examined is in good condition and no large amount of rot is expected to develop. Since the potatoes were planted during weather too cool for the flies to be very active, there is little likelihood that maggots will prove injurious this season. The cool, moist weather has also helped to retard any fusarium development in the seed pieces and it is not likely that much rot from this source will be found this season.

Considerable interest is being shown by the farmers in the yielding qualities of good seed grown in the western part of Virginia at altitudes of approximately 2,000, 3,000, and 4,000 feet elevation. This seed is being tested on eight demonstration plats on the Eastern Shore of Virginia in comparison with seed from Prince Edward Island and New Brunswick, Canada; South Dakota, North Dakota, Maine, New Jersey (second crop), Maryland (Mountain-grown), and Virginia second-crop. The Extension Division will conduct several tours of inspection to visit these plats in June. — **H. H. Zimmerly, Norfolk, Va., March 28.**

Wisconsin. — A series of annual winter conferences will be held in Wisconsin in the interest of the seed potato inspection work of the state. The schedule includes all the important sections of the state where certified seed is produced. Every grower who will apply for inspection in 1924 will be expected to attend.

Among the important questions to come up for consideration are as follows:

1. Standards for 1924.
2. Concentration on varieties adaptable to the trade.
3. Proposed improvement in certification methods.
4. Proposed improvement in grading, shipping, distribution, use of tag — "Badger State Brand", etc.
5. Organization work in 1924 affecting proposed summer tour; work of the Wisconsin Potato Growers Association.

The inspection service will submit a report on the present season's work and certain recommendations will be made for the further development of inspection work.

Plans for a further increase in experimental work on the Spooner Branch Station are under consideration. About 100 growers have agreed to furnish seed stock for the trial plots in 1924.

We are in receipt of samples of the Spaulding No. 4 from Professor Stuart at Washington. The question has been raised, "Is the Spaulding No. 4 of the East identical with the variety known

as King in Wisconsin?" Samples of two varieties will be planted at Spooner for comparison.

It is possible there will be a slight decrease in acreage in the central belt in Wisconsin but probably no falling off in the newer sections of the state. — **J. G. Milward, Univ. Wisconsin, Madison, Wis., March 17.**

NOTES ON RECENT LITERATURE

DEAN, DANIEL—Profit and loss in the potato business.—*Pennsylvania Farmer*, 89:*363, March 15, 1924.* — The author comments on the effect of both adverse and favorable weather conditions upon the yield of the crop. Comparison is made between the relative cost of growing potatoes, on small fields, rough and steep fields, and stony soils, with that on large level areas with few if any stones. His harvesting cost last year on 30 acres of level farm land yielding 7577 bushels was eight cents per bushel for men, teams, and digger, to dig, pick up, and haul to the cellar, whereas on a poorer, stony, and sloping field of 7 acres farther from the storage cellar it cost 18 cents per bushel to dig and store the 1163 bushels that this area produced. The author's comment on this increased cost is that it costs as much or more to grow an acre of potatoes on poor or rough land than on richer and easier operated land and that it is plainly evident the 1924 grower must either quit growing potatoes on his poorer fields which will not pay the labor costs or else grow more bushels by investing in fertilizer, better seed, or better spraying. The desirability of plenty of organic matter in the soil is emphasized. Varieties should be grown that are adapted to the climatic and environmental conditions under which they are to be grown. Good seed should be used and it should be disinfected before it is planted. — **W. Stuart.**

MILLER & CO., ALBERT. — The firm of Albert Miller & Co. has recently issued a booklet entitled "Old Bill Spud Says, etc." This little booklet, which is primarily intended to advertise this firm's brand of "Bill Spud" seed potatoes, contains pertinent information concerning the performance of good and poor seed stock. Their companion charts illustrating the cost of good and poor seed and their productive capacity furnishes striking evidence of the penny-wise and pound-foolish wisdom of the man who buys and plants inferior seed potatoes. The booklet is well illutrated and taken all-in-all it is a worthy effort on the part of this firm to induce the grower to use good seed by presenting convincing evidence of its value. — **W. Stuart.**

MOORE, H. C. — Good possibilities in early potatoes. — *Michigan Farmer* 162:*387, March 15, 1924.* — The author calls the at-

tention of Michigan growers to the possibilities of the profitable production of early potatoes for local markets which can be comfortably reached by truck, or, in the growing of early varieties for seed by those who are too remote from consuming centers. The inadvisability of planting inferior seed stock is especially emphasized, and the grower is told that for better yields and better quality he should plant certified seed. Tests made in Michigan last year on 530 farms showed that where certified seed was used it produced an average of 63 bushels more marketable potatoes than the uncertified or common seed stock. According to the author, special efforts are being made by the Michigan Agricultural College co-operating with the Michigan Potato Growers' Exchange to procure a sufficient quantity of high quality certified seed of early varieties to meet the demands of Michigan growers. The Early Ohio and the Irish Cobbler varieties are recommended. Thorough spraying of the plants is suggesetd. Spray rings have proven popular with many potato growers. Satisfactory yields are considered by the author to be dependent upon good seed, a fertile soil, and thorough spraying.— **W. Stuart.**

MISCELLANEOUS PAPERS

THE POTATO SITUATION

H. R. Smalley, Agronomist Soil Improvement Committee

Potatoes "flow" from centers of surplus production to areas of deficient production, and it is natural to expect that the price received by the farmer will be considerably higher in a potato importing area than in a potato exporting area. This difference in price will, of course, depend upon the cost of transportation, handling charges, storage, commissions, etc. On account of the bulkiness and relative cheapness of potatoes, it occasionally happens in seasons of large surplus production that these marketing costs are as high or higher than the market price, and the grower is unable to dispose of his crop.

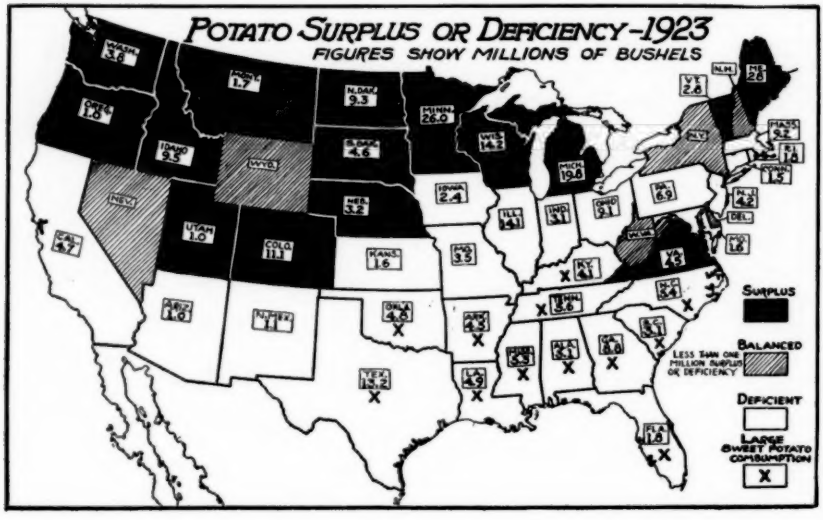
A graphic picture of the potato situation in 1923 is shown by means of the accompanying map. For the purpose of this discussion, it is assumed that the average per capita consumption of potatoes is 3.5 bushels and that seed is used at an average rate of 10 bushels per acre. On this basis of figuring, which certainly cannot be far off, the great potato surplus is produced in Maine, Virginia, the Northern Lake States, and in the Northwest. The territory adjacent to the great eastern cities of Philadelphia, New York and Boston, the "Corn Belt," and the South are the areas of greatest potato deficiency. Incidentally, it is worth while to

mention that the deficiency of white potatoes in the Southern States is largely met by a large local production and consumption of sweet potatoes.

A more detailed analysis of the situation would show that there are surplus areas in deficient states and deficient areas in surplus states. For example, in Maine comparatively few potatoes are grown for market outside of Aroostook County, but the state produced a surplus last year of 28 million bushels. Certain counties in western New York and on Long Island produced a large surplus, but the state as a whole produced practically no surplus. Southeastern Pennsylvania and central New Jersey produce large potato surpluses, but both states, considered in their entirety, show considerable deficits.

These various economic situations have a decided effect on farm practice. For example, a grower in Michigan or Wisconsin — states producing large surplus — where the farm price on December 1st was only 50 cents a bushel, must do everything possible to cut the cost of production. In this process he should not forget, however, that the use of good seed, thorough spraying, and a reasonable application of fertilizer are big factors in reducing the cost per bushel. He should in many cases, no doubt, grow fewer acres and grow them better.

On the other hand, growers who are located in regions of deficient production, as, for example, in Pennsylvania, where the farm price on December 1st was $1.05 per bushel, can well afford to consider some expansion of the potato industry. These growers may well plant a few more acres and can afford to work for maximum yields. In most cases they will be well repaid for relatively large applications of fertiizer.



The map shown above is an attempt to picture, graphically the potato situation. The figures are based on a per capita consumption of 3.5 bushels and 10 bushels of seed per acre. A little study will show that regions of surplus production are regions of low price and that in those states where consumption is greater than production the price is relatively high. This suggests an increase in the production of potatoes in deficient territory and greater efficiency to cut down the cost of production per bushel in surplus territory. In either process, fertilizers intelligently used will play an important part.

TREATING SEED POTATOES WITH HOT FORMALDEHYDE

W. M. Peacock

The treatment of seed potatoes for destroying fungous organisms causing common scab, black scurf or rhizoctonia and other spores such as those of blackleg which may be clinging to the surface of the tuber has been in practice for years. But the treatment of seed potatoes has been practiced only by a comparatively few growers, the reason being that the methods formerly recommended took too much time. The period of treatment formerly recommended was one and one-half to two hours. The hot formaldehyde treatment requires two minutes.

It is reported by Melhus and Gilman (1) that the hot formaldehyde solution penetrates faster into the disease organisms and kills them more rapidly than either the cold solution of formaldehyde or corrosive sublimate.

Directions for using the hot formaldehyde treatment are as follows: Immerse the potatoes in a solution made up in the proportion of two pints of formalin (40 per cent solution of formaldehyde) to thirty gallons of water at a temperature of 118° to 122° F. for two minutes. After the tubers are taken out of the solution they may be left in crates, baskets, or piled to the depth of six to eight inches. They should be covered with wet burlap sacks for one hour. Then they should be allowed to dry.

The grower who has sufficient number of crates or baskets will find it very convenient to use them. Treated potatoes in crates or baskets dry rapidly when exposed to the sunshine and wind after the wet sacks have been removed.

Several devices for maintaining the solution at the proper temperature have been used. Most farmers' ingenuity is so highly developed that they may be able to make use of equipment they already have for treating potatoes with hot formaldehyde. Small lots of potatoes can be treated in wash boilers. Some large growers are using large tanks heated by steam, equipped with an end-

(1) Melhus, I. E., and J. C. Gilman — An Improved Method of Potato Seed Treatment. Iowa Exp. Sta. Cir. 57, Mar. 1919.)

less chain or belt which moves at a rate so that the potatoes are in the solution for two minutes. The writer suggests the use of a hog scalder which has a rack that is lowered and raised by a windlass on each end and a place for building a fire below its tank. The writer has never heard of one being used, but has every reason to believe that hog scalder would be an ideal equipment for treating potatoes with hot formaldehyde. Light firewood or corn cobs make excellent fuel for heating the solution.

This winter P. M. Lombard and the writer have been using a manufactured hot formaldehyde treater at Arlington Farm, Va. It is heated by burning kerosene gas. This outfit has proven to be very satisfactory. The manufacturers state that two men with this equipment can treat two hundred bushels of potatoes per day.

When steam is used to heat the formaldehyde solution there is a condensation of the steam in the formaldehyde solution which will eventually weaken it. The loss in condensation of the solution is very slight when heaters are used. One should have a reserve supply of the solution on hand for maintaining a sufficient quantity in the treating tank and also for lowering the temperature quickly should it become too high.

It is necessary to have a mercury column thermometer that will register 130 ° F. or more. A thermometer with some kind of a float will be found to be convenient.

The treating of seed potatoes in hot formaldehyde solution has been thoroughly tested. It should become very popular since the treatment requires only two minutes and a large amount can be treated in one day. It should be the aim of every potato grower to grow a better product and to reduce the cost of production per bushel. The hot formaldehyde treatment will help to accomplish these two factors.

WHAT SIZE OF SEED PIECE OR SET SHOULD WE PLANT?

W. Stuart

One of the most frequent inquiries received at this season of the year is that pertaining to best size of set to plant. This question is also one of the most difficult to answer correctly for all conditions under which potatoes may be planted.

Mr. T. B. Terry, who was one of the foremost authorities on the commercial production of potatoes a quarter of a century ago, was a firm advocate of the planting of single-eye sets. When questioned by the writer after the delivery of one of his addresses on potato culture he admitted that he had only practiced this method of cutting his seed potatoes on the Early Ohio variety. It was furthermore brought out in the course of this quiz that he always prepared his seedbed with the greatest degree of care possible. A well prepared seedbed was the secret of Mr. Terry's success with

small-size sets. To have the soil in a well-fined condition necessitates frequent disking and harrowing before the field is planted, and as a result the moisture is conserved, thus providing the essential requisites for quick and practically perfect germination of even small-size sets.

On land that is somewhat stony or does not admit of as thorough a preparation of the seedbed as does a sandy loam soil a larger-size set, say one containing from two to three eyes will, one year with another, give better results than the smaller one-eye set. It is apparent, therefore, that certain factors determine, to some degree at least, the best size of set to use. Generally speaking, however, the use of a large-size set guarantees a better stand and consequently a larger crop per acre. In our opinion one should plant from 15 to 20 or more bushels per acre on land that has been well prepared, that is well supplied with organic matter and available plant food, and that naturally possesses a good moisture supply. On such land the planting of from 8 to 12 bushels of seed per acre is little short of criminal as such an amount of seed either means small-size sets or too wide spacing of rows or sets in the row to produce a profitable yield.

On irrigated land and on soil well supplied with plant food the grower may find it profitable to plant whole tubers weighing from two to three or more ounces. The whole tuber will produce more stems or plants per set than an equal size cut set. This results in a larger set of tubers as it is found that the number of tubers produced is closely correlated with the number of stems produced per set. With an abundant supply of moisture a larger proportion of the more numerous tuber progeny will reach marketable size and in consequence will give a relatively larger yield than from the cut set. In addition to this the use of whole sets practically guarantees a perfect stand even when weather conditions are extremely unfavorable during the germinating period. Under such conditions a considerable percentage of cut sets may fail to grow, on account of their drying out is moisture is lacking, or rotting if the soil is too wet.

Taking all these things into consideration therefore, it is desirable to plant a good-size seed piece, say from 1½ to 2 ounces in weight, because as a general rule a better stand will be secured and a larger yield produced per acre.

SUGGESTIONS FOR POTATO SUCCESS IN THE SAN LUIS VALLEY

W. H. Olin, Denver, Col.

The following concrete statements are compiled from the practical experience of commercial potato growers as given by them at the conference of potato growers held in the shipping districts

of San Luis Valley by the Denver & Rio Grande Western System under the general supervision of the three county extension agents in this great mountain valley, February 18th to 23rd inclusive. The writer deems these well worth while and so urges the press of the valley to publish same the first week in March, so those not able to be present at the potato conferences can learn something of what was said.

1. Careful, systematic seed selection is all-important in maintaining quality in potatoes. Planting the screenings from your market stock will, in the long run, bring you loss in lower yield and inferior market stock. "Remember", says Dr. Sandsten, "whatsoever ye sow, that shall ye also reap". Plant for seed the type and character of potato you desire to market.

2. We find that river bottom loam soils, which are quite porous and friable, are well adapted to Russet Burbanks; The heavier soils of Conejos County produce a good quality of Peach Blows with good yields; the sandy loam mesa soils in the floor of the valley give good results with Brown Beauties. Therefore we should hold to these types of late potatoes to the exclusion of all others. The altitude and climate of our valley are not favorable for profitable production of early potatoes. We can not hope to get them on the market before the middle or last of August, when prices for early potatoes are on a toboggan slide downward. We take a gambler's chance whenever we grow them.

3. Potatoes do best when grown after such crops as alfalfa, sweet clover and peas. We must have vegetable mold or humus in our soils for potato crop success. We shoud not grow potatoes on same field oftener than once in 3 years and 5 years is still better. Therefore we believe we should have some type of live stock on our farms to furnish manure and keep up good soil fertility.

4. Diversify the farm crop. Practice that crop rotation best suited to your farm, soil and markets. Twenty-five to forty acres in potatoes every year on a 160-acre farm is better than 50 to 75 acres grown alternate years. The grower maintaining a rotation of crops can more effectively keep out fungus and other plant diseases that prey upon potatoes. Desirable spring wheat, oats and barley have been grown in this valley in the past with satisfactory yields. Sweet clover literally grows wild and makes pasture for all types of live stock.

5. Practice sending to market that type and grade of potatoes you yourself would desire for table use in your own home. When we send culls and off grade potatoes to market they don't bring us anything and they cut down the price that would otherwise be paid for good market stock. Supervisor E. F. McKune, in charge of Federal and state inspection in Colorado, told of an instance where $17.50 worth of low grade potatoes in a car-lot of otherwise good market tubers caused the grower a cut of $103.50 on a given car. This practice turns what might have been a profit into a most serious loss.

6. Use clean new bags for containers. The appearance of the package goes a long way in selling the product on arrival at the terminal market. A medium quality tuber in clean new bags moves more quickly into consumption, and at better prices, than the best quality potatoes put up in dirty and torn bags. Let us keep up to grade and insist on shipping point inspection so we shall all "toe the mark."

7. We should cultivate and stir the soil frequently after planting potatoes so as to keep down weeds and mix air into the soil, keeping it mellow and friable. Mr. Olin's slogan "Irritate more and irrigate less" we consider correct. Mr. Chisholm's statement that potato roots go down 3 or 4 feet has tests of the Colorado Experiment Station to back it up. He also stated that when water table comes above 3 feet it rots off the ends of the roots, cutting off the volume of plant food these roots bring to nourish the growing tubers.

The above suggestions we believe essential for potato success in our valley.

SUMMARY REPORT OF SEED POTATO INSPECTION AND CERTIFICATION IN THE PROVINCE OF ALBERTA, CANADA, IN 1923

H. S. MacLeod, Univ. Saskatchewan, Saskatoon, Sask.

In 1923 there were 98 applications for inspection, involving a total of 151 fields which received a first inspection, and 62 a second inspection. One hundred fields having a total of 161 acres passed the field inspections and 112 acres both field and tuber inspection. The total area rejected was 242 acres. The 112 acres certified produced 24,300 bushels or approximately 217 bushels per acre.

The available supply of well graded certified seed for sale after deducting the needs of the growers and allowing 30 per cent for culls or undesirable stock is estimated at about 7,000 bushels. The approximate acreage and yield of each of the varieties certified is about as follows:

Variety	Acreage	Total yield ungraded	No. bus. well graded seed for sale
Irish Cobbler	52.50	10,560 bu.	2,815 bu.
Gold Coin	24.75	7,400 "	2,780 "
Netted Gem	20.50	2,825 "	475 "
Russet Burbank	7.75	1,730 "	650 "
Empire State	3.00	500 "	125 "
Early Bovee	1.25	420 "	85 "
Early Ohio	1.50	365 "	85 "
Carman No. 3	0.75	300 "	35 "

Most of the 100 fields that passed inspection had been planted with certified seed, and many were of small acreages as the growers in such cases were just beginning this work. Most of the 51 fields that were rejected had been planted with just ordinary uncertified seed (1st year for inspection) and some were of quite large acreage. The vigor and general appearance of the crops were in almost all cases much in favor of the former.

Diseases were found on field inspection as follows:

Blackleg was found in 80 fields and in many quite severe.
Mosaic was found in 103 fields but generally only slight.
Leaf roll was found in 28 fields, generally slight.
Early blight was found in 25 fields from slight to moderate.
Wilt was found in 12 fields from slight to moderate.
Rhizoctonia to some extent in almost every field, but only slight in about 50 per cent of the fields, the other 50 per cent being from moderate to severe.

NOTE:—These numbers are out of 151 fields in each case.

The above diseases together with mixtures of varieties were responsible for the rejection of the 51 fields, rhizoctonia, mosaic, and blackleg being the most prevalent. Blackleg was the cause of more rejections than any other one disease, it often affecting as much as 25 per cent of the plants in fields planted with ordinary uncertified seed. The severity of the three diseases, blackleg, mosaic, and leaf roll, would be in the proportion of about 9:3:1. The averages for total number of fields inspected were 3, 1, and .3 per cent respectively.

Early blight was more prevalent in Alberta this season than it has been here any year since we began potato inspection work in the Province (1920). There was more humidity during the growing season of 1923 than during the same period of any one of the three previous seasons. That probably to some extent also accounts for the higher percentages of blackleg showing in fields that had been planted with ordinary uncertified seed.

The causes for the rejection of the crops at tuber inspection were: rhizoctonia, common scab, internal discoloration (some had developed rot) due to different fusaria and bacteria, bruises (and dry rot following) and some mixtures of varieties. Scab and rhizoctonia are the two most common diseases of the tuber in Alberta. Even where seed had been well treated with corrosive sublimate these two often appeared, which indicates that the organism of each disease, and especially of rhizoctonia, is present in the soil in very many districts in Alberta. These two diseases were more severe in some localities than in others, due no doubt partly to the difference in the amount of moisture and to the time in the season that the moisture fell (or was applied in the case of irrigated farms).

It was quite noticeable that common scab was not as prevalent this past season nor nearly as severe where found as it was in the years of less rainfall.

SOME COMMENTS ON SELECTION WITH SPECIAL REFERENCE TO POTATOES

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Selection is sometimes considered as entirely divorced from breeding and the terms "breeding" and "selection" are used to denote two entirely different processes. But in all work involving crosses or hybrids, selection is a necessary accompaniment of hybridization. It would seem logical, therefore, to consider both hybridization and selection as processes involved in breeding work. Whether or not this definition of breeding is accepted, it is proposed here to discuss the process of selection, **per se,** without any reference to hybridization.

Selection. As is well known, the ideas of plant breeders with respect to selection have changed during the last twenty years, in accordance with the experimental results published by Johannsen, Castle, Pearl and others. Whereas, formerly, selection was thought to be a cumulative process, a gradual building up, by an accumulation of small fluctuations or variations, now, of course, it is generally recognized that selection is a process of isolation or separation of various strains or biotypes which go to make up a variety. By such isolation accompanied by careful progeny tests of the strains obtained, it is possible to separate the superior strains from the inferior; and by increasing the former and using them in general culture, larger yields, for example, are obtained than was possible with the original variety which was composed of the various types. This process of selection does not create anything new, nor does it actually change that which already existed. Selection may be likened to a sieve by means of which the variety may be separated into its component parts.

It is not possible nor desirable here to review the many experiments which lead to the above conclusions with respect to the role of selection. Suffice it to say that, so far as the writer is aware, plant breeders of the present day quite generally agree with this conception so far as the improvement of crops is concerned. It is generally agreed also that the amount of improvement of a crop that can be accomplished by selection is limited and that when this limit is reached it is necessary to resort to hybridization for further advance.

Bud selection. In describing the modern concept of the role of selection in the preceding paragraphs, no distinction was made between sexually propagated and asexually propagated plants. As a matter of fact, all of the experimental work that has been done with asexually propagated organisms has yielded results which are similar to those obtained with sexually propagated organisms, and these results have been interpreted as showing the inefficacy of selection save as a means of isolating types already existing. As to how these different types have come into existence opinions

may differ, but there is unanimity of opinion with respect to the accumulative effect of selection. It is not feasible here to review in detail the literature on this question. Suffice it to say that there is a considerable body of evidence, all of which supports the above statements. But it is true that in most of the selection experiments with asexually propagated plants, the species has not been a cultivated one. Thus, there is a difference of opinion among plant breeders with respect to the efficacy of selection in isolating distinct strains of vegetatively propagated crops, especially with respect to yielding capacity. What experimental data are available are inconclusive and in some cases conflicting. It is pertinent here to review some of these. Considerable work has been done with apples and strawberries at the Missouri Agricultural Experiment Station and with strawberries at the Oregon Station. The work at Missouri which was initiated by the late Professor Whitten, has often been referred to. Gardner[1] has given a detailed summary of these two pieces of work. In the case of the apples, yields were obtained for ten years from two groups of trees. One of these groups had been propagated by scions from a parent tree which had been a regular and heavy producer of high grade fruit, while the other group had for its origin a parent tree which had been a low producer of fruit of inferior size and quality. The resulting crops of these two groups of trees, which were accurately measured for a period of ten years, showed no significant difference in "productiveness, regularity of bearing and grade of fruit." In the case of strawberries at Missouri, similar conclusions were drawn with respect to two groups of plants, which had originated from six mother plants. With strawberries at the Oregon Station, there was some evidence that different strains might be isolated by selection. It is unfortunate with regard to the above experiments that larger numbers of individuals were not included in the original selections. Only two apple trees were chosen, and with the strawberries six was the largest number of individuals from any one variety which were included in the original selections.

Another piece of bud selection work with apples is reported by Davis.[2] In an orchard in which yields of individual trees had been measured for a number of years, three parent trees were chosen — the heaviest yielding one, the poorest yielding one, and the heaviest most regular bearing one. Scions were taken from each of these three trees and root-grafted on crab stock, and the yields of the resulting progeny were measured for nine years. Buds from the three original parental trees were also top-worked on five different trees; that is, buds from each of the three parental trees were

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(1) Gardner, V. R.—Bud selection with special reference to the apple and strawberry.—Missouri Agr. Exp. Sta. Res. Bul. 39. 1920.

(2) Davis, M. B.—The possibility of transmission by asexual propagation of the high yielding ability of apple trees.—Scientific Agr. 2: 120-124. Dec., 1921.

grafted on to each of the five trees chosen for that purpose, care being taken to alternate the positions of the grafts with respect to exposure and the like. The yields from these top-grafts were measured for five years. In both of these experiments reported by Davis, the results indicated that there was a tendency to transmit the yielding characteristics of the parent in the asexually propagated progeny of these apple trees. But here, again, the number of individuals included in the original selection was only three.

A large amount of bud selection work has been done with citrus fruits in the United States. It is not practicable here to cite the various publications in which the different phases of this work have been reported. The most important of these are cited by Shamel[3] in a report in which he gives progeny performance records of stocks from unproductive and normally productive limbs, and concludes "that the number or quantity of fruit produced by citrus trees is a transmittable character capable of perpetuation through bud propagation."

It is evident from the above experiments, which are typical of others that might be cited, that the efficacy of bud selection as a means of improvement applied to apple trees and strawberries is a mooted question. The experimental data are inconsistent and inadequate. In the case of citrus fruits, the data are more consistent but they are subject to criticism and are not yet complete enough. In the case of the apple and citrus fruits, there are many obstacles in the way of experimentation along this line. Some of these are the length of time necessary to obtain results, the difficulty of handling large numbers, soil heterogeneity, and the difficulty of properly evaluating the effect of stock upon scion. These obstacles ought not to be insurmountable but they do necessitate the use of more exact methods of experimentation than have heretofore been used, if reliable conclusions are to be drawn.

Bud selection with potatoes. It might seem at first thought that the preceding paragraphs, dealing with bud selection as applied to fruit trees, were irrelavant in a discussion of potatoes. To a certain extent this is true, for one is not justified in drawing an anology between potatoes and apples in regard to their response to selection. But, since potatoes are also propagated asexually, for the most part, there has been an inclination on the part of some workers to discredit selection of potatoes on the basis of the work done on apples and strawberries. Even if it were an established fact that within a variety of apples strains differing in productivity could not be isolated by selection, it would not be safe to assume the same state of affairs with potatoes. It is possible and indeed probable that certain species are more variable than others.

A number of selection experiments dealing with potatoes have

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(3) Shamel, A. D., et al.—Bud selection as related to quantity production in the Washington Naval Orange.—Jour. Agr. Research, Vol. XXVI, No. 7, pp. 319-322, Nov. 17, 1923.

been reported. The data and interpretations have been conflicting in some instances. To the writer it seems evident that a number of factors have contributed to this contradictory state of affairs. He has been led to look for these contributory factors because, in his own experiments, the results have so consistently pointed to the efficacy of individual selection as a means of improvement. There seems to be at least three such contributory factors.

The effect of diseases. The first of these is the matter of disease, among which the so-called degeneration diseases are probably the most perplexing. On account of these, many hill or tuber unit selection experiments have yielded no results, for it has been impossible to continue the work beyond a very limited time because of the complete degeneration of the stocks. It is true that such extreme cases occur usually in regions where the environmental conditions are unusually favorable to the disease, and are relatively infrequent in regions well adapted to seed potato growing. Under the latter conditions, individual selection is very useful in helping to eliminate disease and some have gone so far as to assert that this is the only function of tuber or hill unit selection. To the writer, however, the evidence does not seem to justify the conclusion that all variation in productivity is due merely to varying amounts or intensities of infection by disease.

Misconception of function of selection. A second cause of contradictory results and interpretations has been a misconception of the limitations involved in the pure line concept. Many of the experiments with potatoes have been conducted in a manner to test the effect of selection within tuber or clonal lines, instead of testing the effect of selection as a means of isolating tuber lines or clons from a variety. In the first instance, judging from many carefully planned experiments with different asexually propagated organisms, one would expect negative results; while in the second instance positive results might reasonably be expected, for in practically all of the experiments referred to no change resulted from selection within clonal lines but in many instances the lines which were isolated by the original selection were distinctly different from each other. It is true that mutations sometimes occurred during the course of the experiments and gave rise to new lines, but it is rather improbable that these were caused by the selection. Further, the new lines thus formed were relatively as stable as the line from which they sprung. It is also true that mutations must have occurred at various times in the history of the species under investigation, else it would not have been possible to obtain these different clonal lines.

The statement is often made that no variety of potatoes has ever been obtained by selection. This statement is not altogether correct. While it is true that practically all varieties of potatoes have originated as seedlings, it is also true that in a few cases lines have been isolated by selection which were sufficiently different from the parent stock to be classified as a separate variety. This

has occurred four times in the writer's experience. Such striking mutations are comparatively infrequent but smaller changes seem to occur with greater frequency. That is, within a given variety a number of lines may be isolated, which differ from each other slightly and which are constant. But they still maintain the general characteristics of the parent variety and would be correctly classified as belonging to that varietal group. It would seem that a careful distinction between the term "variety" and "strain" would be helpful here, using the former term as a general one covering a varietal group as, for example, Rural New Yorker, while the latter term is applied to definite, distinct tuber lines, each of which traces its origin to a single parental individual or tuber. Varieties should be differentiated on the basis of grosser morphological characteristics. Strains should be differentiated on the basis of lesser morphological characteristics and possibly physiological reactions. In the light of the above definition, the writer has no difficulty in experimentally demonstrating that an ordinary variety of potatoes may be separated into a number of definite, distinct strains which differ with respect to slight morphological characteristics and productivity.

Inadequate methods of testing. The third and probably most important factor, entering into the contradictory results and interpretation of selection experiments with potatoes, is the technic that has been employed in making comparative tests. If the pure line concept as we have stated it here is correct, and so far as we know there is no disagreement on this point, the first selection is the only one of any particular value. From then on it is merely a question of accurately measuring the performance record of the progeny of the original selections, since selection within a clon is of no avail in changing the type except in the rare occasions when bud mutations occur. But the technic employed in making comparative tests of the various strains isolated by the original selection is very important. Careful consideration must be given to such questions as concern the size of plats, number of replications, effect of competition, seasonal variation, and the like. Unfortunately, this has not always been done, and the conclusions drawn from many experiments are invalidated when due consideration is given to these questions. It is not the purpose here to discuss this matter in detail. The writer[4] has already pointed out some of these considerations, and has suggested the use of single row plats containing from twenty-five to fifty hills each and that each lot to be tested should be replicated nine times. It also seems desirable that such a test should be conducted for at least three years, or longer, in order to properly measure seasonal variation. In a recent paper, Salaman,[5] working in England, has arrived at similar conclusions with respect to size of plat and number of replications. A careful study of reports of comparative tests of various kinds with potatoes reveals the fact that in very few instances have such adequate methods been employed. Such meth-

References 4 and 5 on next page.

ods of testing are not usually essential for the determination of the morphological differences mentioned above, but they are certainly necessary if one is to distinguish differences in strains with respect to productivity, which is influenced not only by environmental but also by inherent factors.

The work of co-operative marketing organizations is leading inevitably to standardized products. This statement holds for potatoes as with other crops. We need to know not only what are the best one or two varieties for a given region, but also what are the best strains of those varieties. Certification is serving a most useful function in providing disease-free seed, but it should go further and also take into consideration the ancestry of the seed.

THE PRESENT STATUS OF INVESTIGATION OF VARIETAL RESISTANCE TO DISEASE IN THE POTATO

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PART I

Ever since the devastating epidemic of late blight swept the potato fields of northwestern Europe in 1845 and succeeding years, the problem of securing disease-resistant varieties of this important crop has been of lively interest. A very extensive body of literature has been built up comprising the results of numerous tests of varietal performance in the presence of the more important potato diseases. Some of these reports are based on large scale experiments in which collections of several score of varieties have been grown under conditions that were uniform or uniformly varied in time or place so as to bring into the experiment a variety of weather and soil types. A larger proportion of this literature on disease resistance in potatoes consists only of isolated or fragmentary observations based on incomplete knowledge of the factors involved and therefore not susceptible of comparison with other conditions and observations. The paucity of the results presented in many of the papers which swell the literature on this subject, and the frailty of support for many of the conclusions drawn are of course not evident from an inspection of the titles. In order to arrive at a sound understanding of just what has been established in respect to differential susceptibility to dis-

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(4) Myers, C. H., and F. R. Perry—Analysis and interpretation of data obtained in comparative tests of potatoes.—Jour. Amer. Soc. Agron., Vol. 15, No. 6. pp. 239-253. 1923.

(5) Salaman, R. N.—The determination of the best method for estimating potato yields, together with a further note on the influence of size of seed on the character and yield of the potato.—Jour. Agr. Sci., Vol. XIII, Part 4, pp. 316-389. 1923.

eases exhibited by our potato varieties, the writers have had in hand for the past two years a thoroughgoing examination and compilation of this literature. It seems that the present is an appropriate time to present in summary form the results of this examination. Not since 1905, when Jones (13) assembled and critically reviewed the observations and experimental data relating to this subject which had been gathered principally in Europe up to that time, has a general review appeared in American literature, although the best experimental evidence that has been adduced to show varietal differences toward disease has appeared since that time, and indeed nearly all recent investigations dealing with potato diseases have taken into consideration, and reported on, the relation of the variety to the destructiveness of the disease. The entire existent body of knowledge relating to the so-called virus diseases of the potato — mosaic, leafroll, and spindle-tuber — has grown up since 1905, and no review of the subject of disease resistance in the potato can be complete without reference to this important group of diseases. However, so large a proportion of the literature on disease resistance involves merely incidental observations and repetition of previous conclusions that a complete annotated bibliography, while of interest, would not be worth publishing. The status of the problem, as it relates to American varieties, with brief mention of the conclusions which seem to be best founded in respect to European varieties, can be reduced to brief terms.

There appear to have been three principal phases in the investigation of disease resistance in potatoes, both in Europe and in the United States. Characteristic of the first was the effort to secure resistance to late blight, an attempt which met with a measure of success in Europe, but which in this country has been temporarily displaced by the development of very effective means of protection even of susceptible varieties against this disease. The second phase was inaugurated by the spread of potato wart in Europe and its introduction into America. Since the use of immune varieties offered the only practicable means of control, renewed attention was given to variety tests for disease resistance. This phase is noteworthy, too, for the demonstration of the existence of complete immunity to a disease among the closely similar varieties of potatoes. Toward other diseases, only a more or less high degree of resistance has been observed. The third phase resembles the second in the urgency which it engenders of securing resistant varieties as one of the means of coping with the spread and destructiveness of the insidious degeneration diseases. In the succession of these phases there is observable a trend toward more precise control of the conditions under which judgment as to disease resistance is made, toward greater co-operation of pathologists and plant breeders to attain the common end, and toward hybridization, using material of known potentiality, as the most effective procedure.

The review by Jones (13) of disease resistance of potatoes already referred to, first brought this subject to the general attention of pathologists and potato breeders in this country. Stuart had begun in 1903-04 to test American varieties for reaction to late blight and other diseases. The collection of varieties brought back from Europe by Jones, however, and the co-operative experimental arrangement which brought into the investigation the Bureau of Plant Industry of the U. S. Department of Agriculture, and the agricultural experiment stations of Vermont and Maine made possible a thoroughgoing study of the problem of resistance to late blight. This work has been reported fully and is readily accessible in the publications of the Vermont and Maine Agricultural Experiment Stations cited in the bibliography appended to this article. Therefore only a brief summary of this classical chapter in the history of potato investigations in America need be given here.

This work extended from 1903 to 1912. Though primarily planned to test for resistance to late blight, supplementary observations were made on reaction to early blight (***Macrosporium solani***), tip burn, and common scab (***Actinomyces scabies***). A varietal collection comprising about 60 American and 90 European names was at hand for the test in 1905, but was not carried throughout the entire period.

In the same year the entire collection was duplicated in two plots, one on light, the other on heavy soil, and favorable meteorological conditions for a severe epidemic of blight prevailed. In several of the succeeding years late blight was mild or absent. However, the test during the entire period served to establish the approximate relation of American varieties to this and other diseases, and additional evidence furnished by subsequent trials has in the main confirmed these results. Along with the field tests, laboratory studies of the late blight fungus, ***Phytophthora infestans***, were carried on to determine its ability to attack the foliage and the tubers of all these varieties under controlled conditions, and also to examine certain properties of the varieties which might possibly influence their response.

It was found that European potatoes were in general more resistant to Phytophthora than American varieties, a condition attributed to the attention given by European breeders to blight-resistance since the epidemic of 1845. The varieties Apollo, Wohltmann, and Sophie were first in this respect. Rustproof, a variety of no commercial importance, was the only American sort showing pronounced foliage resistance, though Keeper, Dakota Red, American Wonder, Late Blightless, and Doe's Pride showed resistance to tuber rot. Laboratory tests of infection gave results in agreement with the field experiments. Both methods of experimentation agreed in demonstrating that whereas resistance of the foliage to blight is usually correlated with resistance of the tuber to rot, this is not always so. Although a number of European varieties, particularly those from Holland and Germany, exhib-

ited marked resistance, they were found poorly suited to American requirements owing to low yield under our conditions and to undesirable quality. Their contribution to the development of blight-resistant potatoes in America was therefore limited to the indirect one attainable through hybridization of communicating their resistance to new productions. Selection of disease-free individuals did not lead to an increase of resistance within a variety. In general, blight resistance was correlated with an upright growth habit, moderate branching, and firm leaves of medium size which are conspicuously hairy.

In 1917 Harris (8) published an interesting study giving the results of a mathematical analysis of the data secured in the Vermont tests. He determined to what degree the results secured in different phases or periods of the experiment were in agreement and also how resistance to one disease was correlated with resistance to another. He found a coefficient of correlation of .653 ± .041 for percentage of late blight tuber rot on sandy soil as compared with the infection of the same varieties on clay soil; .584 ± .059 for growth of Phytophthora on tubers under laboratory conditions compared with percentage of tuber rot on heavy soil; and .594 ± .055 for laboratory growth of the pathogen compared with tuber rot on sandy soil. These constants indicate close correspondence in varietal susceptibility to tuber rot under the three conditions involved. An even more outstanding feature of this analysis is the mathematical demonstration of the probability that real varietal differences occur in respect to late and early blight, and to scab; and furthermore that resistance to one disease is correlated with resistance to another. Harris states that "the determinations taken collectively certainly furnish highly convincing evidence that to a considerable extent susceptibility to disease is general rather than specific."

Furthermore, tests were carried on by Lutman (15) from 1914 to 1917 in order to secure additional information on the reaction of American potatoes to common scab. Although this work was a continuation of the earlier Vermont varietal tests, the results do not appear in Harris' analysis. The hypothesis advanced by Harris may therefore stand as the culmination of the first period in our study, and Lutman's results will be referred to in greater detail further on.

The fact of very striking varietal differences in the susceptibility of potatoes to wart was first noted in England about 1908 and had been fully established by 1914. When this disease was discovered in the United States varietal tests were begun at once which, during the succeeding four years, have shown beyond reasonable doubt that varieties like Green Mountain, Irish Cobbler, Spaulding No. 4, McCormick, and Burbank never develop visible symptoms of this disease however exposed to it. The extensive variety tests carried out at Ormskirk, England, at Bonn and elsewhere in Germany, and at Freeland, Pennsylvania, in

which varieties have been exchanged and exposed to infection under all sorts of conditions, render it certain that we have here to deal not with limited, but absolute, resistance to disease. Furthermore, such resistance is inherited, and a study by Salaman and Lesley show that the inheritance of immunity and susceptibility may be represented by the customary Mendelian notation. immunity being dominant. This is the first demonstration of inheritence of disease resistance in the potato comparable with recent studies in the inheritance of rust resistance in cereals in which plant breeders and pathologists have collaborated so successfully.

The third and present stage of the historical development is characterized by the application of strict experimental methods to the determination of resistance to disease, usually working with pure cultures of parasitic organisms and carrying out infection experiments under controlled conditions. Of equal importance is the application of genetic principles to the study of seedling progenies derived from crosses in which disease resistance is a principal factor. Only a beginning may truly be said to have been made with these methods, but it appears that the procedure outlined is essential to real progress in the solution of this problem; and if much really is to be hoped for in procuring resistant varieties to combat potato diseases, work now in hand should indicate the possibilities. The most extensive project based on this procedure is that supported co-operatively by the Bureau of Plant Industry of the U. S. Department of Agriculture and the Maine Agricultural Experiment Station. At present efforts are primarily directed toward determining whether resistance to the degeneration diseases — mosaic, leafroll, spindle-tuber, and streak — really exists, and if so whether resistance to one or more of these maladies can be combined. At the same time the reaction to the familiar parasitic diseases is not lost sight of, but obviously the complexity of dealing with the whole problem at once makes it necessary at first to concentrate on the more urgent requirements.

The Bureau of Plant Industry in collaboration with the Agricultural Experiment Station of Pennsylvania is continuing its studies of the inheritance of immunity to potato wart in American varieties, and attempting to produce experimentally a wart-immune Rural New Yorker type. At Cornell Uninversity, work is being carried on to determine how resistance to late blight is inherited in crosses between resistant and susceptible varieties.

In the following paragraphs will be given a resume of present information respecting the varietal resistance of American potatoes to disease. In conclusion, there is a selected bibliography in which the principal original contributions to such information, as well as articles giving comprehensive reviews and abstracts, are cited. A great many more titles have been listed and the references consulted, but without finding any further material that is likely to be of much interest or value to students of this subject.

(To be concluded)